January 2010

Type Y696 Vapor Recovery Regulator

W5996

Figure 1. *Type Y696 Vapor Recovery Regulator*

Features

- **Simplicity**—Direct-operated, straight forward stem and lever design minimizes the number of parts while providing excellent regulation of pressure.
- **Precision Control**—Large diaphragm area provides very accurate throttling control at low set pressures.
- **Rugged Construction**—Heavy duty castings and internal parts are designed to lessen vibration and shock.
- **Ease of Inspection and Maintenance**—The union nut connection permits maintenance or inspection of critical parts without removing the body from the line.
- **Variety of Construction Materials**—Body and lower casing are available in cast iron, steel, stainless steel, or Hastelloy® C. Spring case is available in cast iron, steel, or stainless steel. Trim is available in stainless steel or Hastelloy® C.

Introduction

The Accu-Pressure™ Type Y696 is a direct-operated vapor recovery regulator with internal registration, requiring no downstream control line. This regulator is used to sense an increase vessel pressure and vent excessive internal tank pressure to an appropriate vapor recovery disposal or reclamation system. However, inlet pressures, outlet pressures, and other performance characteristics vary according to construction.

Hastelloy® C is a mark owned by Haynes International, Inc.

D102054X012

Specifications

Body Size and End Connection Style[1]
See Table 1

Maximum Allowable Inlet and Outlet Pressure[2]
15 psig (1,0 bar)

Orifice Diameter
1-inch (25 mm)

Control Pressure Ranges
See Table 2

Flow Capacities
See Table 7

Wide-Open Flow Coefficients
C_V: 14.7
C_g: 515
C_1: 35

Pressure Registration
Internal

Vent Connections
1/4 NPT

Spring Case Connection
1/4 NPT

Common Services and Material Compatibility
See Tables 3 and 4

Temperature Capabilities[2]
Nitrile (NBR): -20° to 180°F (-29° to 82°C)
Fluorocarbon (FKM): 40° to 300°F (4° to 149°C)
Perfluoroelastomer (FFKM): 0° to 300°F (-18° to 149°C)
Ethylenepropylene (EPDM): -20° to 275°F (-29° to 135°C)

Approximate Weight
Cast iron: 45 pounds (20 kg)
Steel and Stainless Steel: 57 pounds (26 kg)

Construction Materials
Body and Union Nut: Cast iron, Steel, CF8M Stainless steel, or Hastelloy® C
Spring Case: Cast iron, Steel, or CF8M Stainless steel
Diaphragm Case Assembly: Cast iron, Steel, CF8M Stainless steel, or Hastelloy® C
Control Spring, Control Spring Seat, and Diaphragm Plate: Plated Steel
Diaphragm: Nitrile (NBR) (**standard**), Fluorocarbon (FKM), or Ethylenepropylene (EPDM)
Disk Assembly: 303 Stainless steel disk holder with Nitrile (NBR) or Ethylenepropylene (EDPM) disk; 316 Stainless steel disk holder with Nitrile (NBR), Fluorocarbon (FKM), Perfluoroelastormer (FFKM), or Polytetrafluoroethylene (PTFE) disk; or Hastelloy® C disk holder with PTFE disk
Orifice, Pusher Post, Lever Assembly, Stem, and Cotter Pin: 303 Stainless steel, 316 Stainless steel, or Hastelloy® C
Gaskets: Composition

1. End connections for other than U.S. standard can usually be provided, consult your local Sales Office.
2. The pressure/temperature limits in this Bulletin or any applicable standard limitation should not be exceeded.

Table 1. *Body Sizes and End Connection Style*

BODY SIZE, NPS (DN)	BODY MATERIAL			
	Cast Iron	Steel	Stainless Steel	Hastelloy® C
1-1/2 and 2 (40 and 50)	NPT	NPT, SWE, CL150 RF, CL300 RF, PN 16/25/40	NPT, SWE, CL150 RF, CL300 RF, PN 16/25/40	CL150 RF

Table 2. *Control Pressure Ranges*

CONTROL PRESSURE RANGE	SPRING PART NUMBER	SPRING COLOR	SPRING WIRE DIAMETER, INCHES (mm)	SPRING FREE LENGTH, INCHES (mm)
2 to 5-inches w.c. (5 to 12 mbar)[1][2]	1A200127022	Red	0.135 (3,43)	5.38 (137)
5 to 15-inches w.c. (12 to 37 mbar)[1][2]	1B766627062	Gray	0.156 (3,96)	6.63 (168)
8-inches w.c. to 1 psig (20 to 69 mbar)	0B019427052	Dark Green	0.187 (4,75)	6.00 (152)
1 to 2.8 psig (69 mbar to 0,19 bar)	0A081127202	Orange	0.250 (6,35)	6.00 (152)
2 to 3.5 psig (0,14 to 0,24 bar)	0Y066427022	Green stripe	0.363 (9,22)	6.00 (152)
4 to 7 psig (0,28 to 0,48 bar)	1H802427032	Red	0.406 (10,3)	6.00 (152)

1. Spring ranges based on spring case installed pointed down. When installed pointed up, spring range increases 2-inches w.c. (5 mbar).
2. Do not use Fluorocarbon (FKM) diaphragm with these springs at diaphragm temperatures lower than 60°F (16°C).

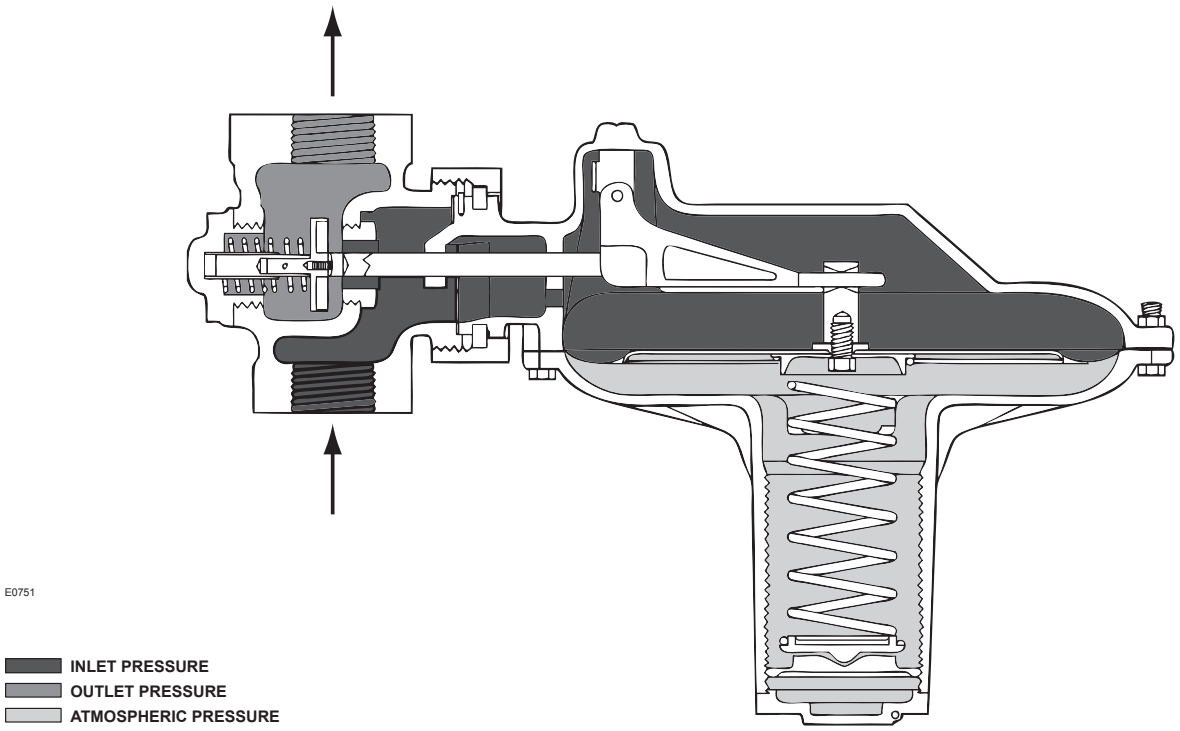

Figure 2. *Operational Schematic*

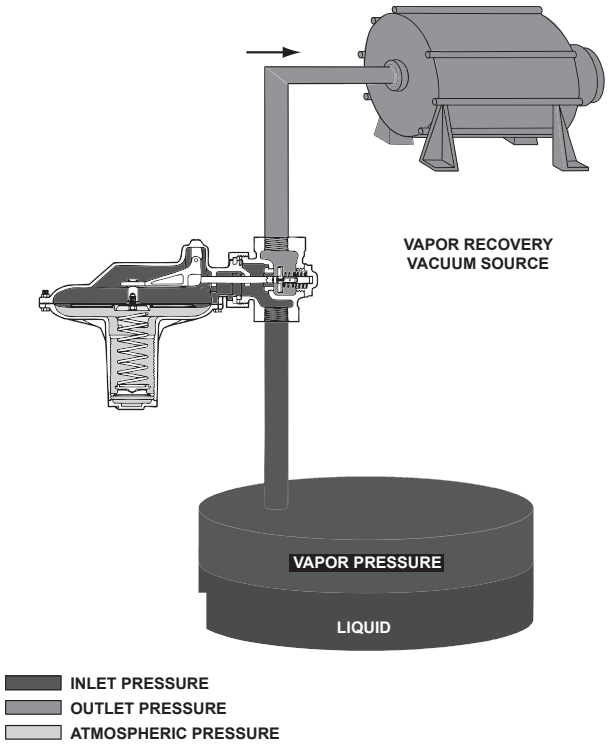

Figure 3. *Principal of Operational Schematic*

Principle of Operation

The Type Y696 vapor recovery regulator is used to maintain a constant blanket (inlet) pressure or vessel pressure with the outlet flowing to a system whose pressure is lower than that at the inlet.

When vessel pressure increases above the setpoint of the regulator due to pumping in or thermal heating, the force of the control spring is overcome by pressure acting on the diaphragm. This moves the disk away from the orifice allowing gas to flow from the vessel to the vapor recovery system.

As vessel pressure is reduced, the force of the control spring causes the disk to move toward the orifice decreasing the flow of gas out of the vessel. As vessel pressure drops below the setpoint of the regulator, the disk will seat against the orifice shutting off the flow of gas.

Sizing Vapor Recovery Systems

To determine the capacity required, you must consider the amount of blanketing gas that must be displaced from the tank when either filling the vessel with liquid (pump-in) or the expansion of tank vapors during atmospheric thermal heating.

Using the established procedures from American Petroleum Institute Standard 2000 (API 2000), determine the required flow rate for outbreathing.

Table 3. *Fluid Compatibility of Metals*

FLUID	MATERIAL				FLUID	MATERIAL			
	Carbon Steel	Cast Iron	316 Stainless Steel	Hastelloy® C		Carbon Steel	Cast Iron	316 Stainless Steel	Hastelloy® C
Acetaldehyde	A	A	A	A	Hydrochloric Acid, Aerated	C	C	C	B
Acetic Acid, Air Free	C	C	B	A	Hydrochloric Acid, Air free	C	C	C	B
Acetic Acid, Aerated	C	C	A	A	Hydrofluoric Acid, Aerated	B	C	B	A
Acetic Acid Vapors	C	C	A	A	Hydrofluoric Acid, Air free	A	C	B	A
Acetone	A	A	A	A	Hydrogen	A	A	A	A
Acetylene	A	A	A	A	Hydrogen Peroxide	IL	A	A	B
Alcohols	A	A	A	A	Hydrogen Sulfide, Liquid	C	C	A	A
Aluminum Sulfate	C	C	A	A	Magnesium Hydroxide	A	A	A	A
Ammonia	A	A	A	A	Mercury	A	A	A	A
Ammonium Chloride	C	C	B	A	Methanol	A	A	A	A
Ammonium Nitrate	A	C	A	A	Methyl Ethyl Ketone	A	A	A	A
Ammonium Phosphate	C	C	A	A	Milk	C	C	A	A
Ammonium Sulfate	C	C	A	A	Natural Gas	A	A	A	A
Ammonium Sulfite	C	C	A	A	Nitric Acid	C	C	B	B
Aniline	C	C	A	A	Oleic Acid	C	C	A	A
Asphalt	A	A	A	A	Oxalic Acid	C	C	B	A
Beer	B	B	A	A	Oxygen	A	A	A	A
Benzene (Benzol)	A	A	A	A	Petroleum Oils, Refined	A	A	A	A
Benzoic Acid	C	C	A	A	Phosphoric Acid, Aerated	C	C	A	A
Boric Acid	C	C	A	A	Phosphoric Acid, Air Free	C	C	A	A
Butane	A	A	A	A	Phosphoric Acid Vapors	C	C	B	IL
Calcium Chloride (Alkaline)	B	B	B	A	Picric Acid	C	C	A	A
Calcium Hypochlorite	C	C	B	A	Potassium Chloride	B	B	A	A
Carbolic Acid	B	B	A	A	Potassium Hydroxide	B	B	A	A
Carbon Dioxide, Dry	A	A	A	A	Propane	A	A	A	A
Carbon Dioxide, Wet	C	C	A	A	Rosin	B	B	A	A
Carbon Disulfide	A	A	A	A	Silver Nitrate	C	C	A	A
Carbon Tetrachloride	B	B	B	A	Sodium Acetate	A	A	A	A
Carbonic Acid	C	C	B	A	Sodium Carbonate	A	A	A	A
Chlorine Gas, Dry	A	A	B	A	Sodium Chloride	C	C	B	A
Chlorine Gas, Wet	C	C	C	B	Sodium Chromate	A	A	A	A
Chlorine, Liquid	C	C	C	A	Sodium Hydroxide	A	A	A	A
Chromic Acid	C	C	B	A	Sodium Hypochloride	C	C	C	A
Citric Acid	IL	C	A	A	Sodium Thiosulfate	C	C	A	A
Coke Oven Gas	A	A	A	A	Stannous Chloride	B	B	A	A
Copper Sulfate	C	C	B	A	Stearic Acid	A	C	A	A
Cottonseed Oil	A	A	A	A	Sulfate Liquor (Black)	A	A	A	A
Creosote	A	A	A	A	Sulfur	A	A	A	A
Ethane	A	A	A	A	Sulfur Dioxide, Dry	A	A	A	A
Ether	B	B	A	A	Sulfur Trioxide, Dry	A	A	A	A
Ethyl Chloride	C	C	A	A	Sulfuric Acid (Aerated)	C	C	C	A
Ethylene	A	A	A	A	Sulfuric Acid (Air Free)	C	C	C	A
Ethylene Glycol	A	A	A	IL	Sulfurous Acid	C	C	B	A
Ferric Chloride	C	C	C	B	Trichloroethylene	B	B	A	A
Formaldehyde	B	B	A	A	Turpentine	B	B	A	A
Formic Acid	IL	C	B	A	Vinegar	C	C	A	A
Freon, Wet	B	B	A	A	Water, Boiler Feed	B	C	A	A
Freon, Dry	B	B	A	A	Water, Distilled	A	A	A	A
Furfural	A	A	A	A	Water, Sea	B	B	B	A
Gasoline, Refined	A	A	A	A	Zinc Chloride	C	C	C	A
Glucose	A	A	A	A	Zinc Sulfateilled	C	C	A	A

A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory
IL - Information lacking

1. Determine the flow rate of blanketing gas displaced when liquid is being pumped in (see Table 6).
2. Determine the gas flow rate due to “outbreathing” caused by atmospheric thermal heating (see Table 5).
3. Add the requirements of 1 and 2 and select a vapor recovery regulator size based on total capacity required from Table 7.

Sample sizing problem:

Vessel Capacity . . . . . 168 000 gallons (636 000 liters)
Pump In Capacity . . . . . 50 GPM (189 l/min)
Desired Vapor Recovery . . . . . 2-inches w.c. (5 mbar)
Vapor Recovery Vacuum Source . . . . . 5-inches Hg

1. From Table 6 the desired air flow rate due to pump in equals 50 GPM (189 l/min) x 8.01 = 400 SCFH (10,7 Nm^3/h) air.

Table 4. *Fluid Compatibility of Elastomers*

FLUID	MATERIAL				
	Neoprene (CR)	Nitrile (NBR)	Fluorocarbon (FKM)	Ethylenepropylene (EPDM)	Perfluoroelastomer (FFKM)
Acetic Acid (30%)	B	C	C	A	A
Acetone	C	C	C	A	A
Air, Ambient	A	A	A	A	A
Air, Hot [200°F (93°C)]	C	B	A	A	A
Alcohol (Ethyl)	A	C	C	A	A
Alcohol (Methyl)	A	A	C	A	A
Ammonia (Anhydrous)(Cold)	A	A	C	A	A
Ammonia (Gas, Hot)	B	C	C	B	A
Beer	A	A	A	A	A
Benzene	C	C	B	C	A
Brine (Calcium Chloride)	A	A	B	A	A
Butadiene Gas	C	C	B	C	A
Butane (Gas)	A	A	A	C	A
Butane (Liquid)	C	A	A	C	A
Carbon Tetrachloride	C	C	A	C	A
Chlorine (Dry)	C	C	A	C	A
Chlorine (Wet)	C	C	B	C	A
Coke Oven Gas	C	C	A	C	A
Ethyl Acetate	C	C	C	B	A
Ethylene Glycol	A	A	A	A	A
Freon 11	C	B	A	C	A
Freon 12	A	A	B	B	A
Freon 22	A	C	C	A	A
Freon 114	A	A	B	A	A
Gasoline (Automotive)	C	B	A	C	A
Hydrogen Gas	A	A	A	A	A
Hydrogen Sulfide (Dry)	A	A(1)	C	A	A
Hydrogen Sulfide (Wet)	B	C	C	A	A
Jet Fuel (JP-4)	B	A	A	C	A
Methyl Ethyl Ketone (MEK)	C	C	C	A	A
MTBE	C	C	C	C	A
Natural Gas	A	A	A	C	A
Nitric Acid (50 to 100%)	C	C	B	C	A
Nitrogen	A	A	A	A	A
Oil (Fuel)	C	A	A	C	A
Propane	B	A	A	C	A
Sulfur Dioxide	A	C	A	A	A
Sulfuric Acid (up to 50%)	B	C	A	B	A
Sulfuric Acid (50 to 100%)	C	C	A	B	A
Water (Ambient)	A	A	A	A	A
Water [at 200°F (93°C)]	C	B	B	A	A

1. Performance worsens with hot temperatures.
A - Recommended
B - Minor to moderate effect. Proceed with caution.
C - Unsatisfactory
N/A - Information not available

2. From Table 5 the desired air flow rate = 4000 SCFH (107 Nm^3/h) air due to thermal heating.
3. Total required flow rate = 4400 SCFH (118 Nm^3/h) air. 4400 SCFH (118 Nm^3/h) converts to 4500 SCFH (121 Nm^3/h) nitrogen.
4. From Table 7, with a 2-inches w.c. (5 mbar), and an outlet pressure of 5-inches Hg, an NPS 1-1/2 or 2 (DN 40 or 50) body size would flow 5130 SCFH (137 Nm^3/h) nitrogen. This would satisfy the desired flow rate of 4500 SCFH (121 Nm^3/h) nitrogen.

Capacity Information

Table 7 gives typical nitrogen regulating capacities at selected inlet pressures and outlet pressure settings. Flows are in SCFH (at 60°F and 14.7 psia) and Nm^3/h (at 0°C and 1,01325 bar) of 0.97 specific gravity nitrogen. For gases of other specific gravities, multiply the given SCFH capacity of nitrogen by 0.985, and divide by the square root of the appropriate specific gravity of the gas required. Then, if capacity is desired in Nm^3/h, multiply SCFH by 0.0268.

***Table 5**. Gas Flow Required for Thermal Heating (Outbreathing) per API 2000 (Interpolate for Intermediate Sizes)*

TANK CAPACITY, BARRELS	TANK CAPACITY, GALLONS	OUTBREATHING (FLASH POINT < 100°F OR NORMAL BOILING POINT < 300°F), SCFH AIR
60	2500	60
100	4200	100
500	21 000	500
1000	42 000	1000
2000	84 000	2000
3000	126 000	3000
4000	168 000	4000
5000	210 000	5000
10 000	420 000	10 000
15 000	630 000	15 000
20 000	840 000	20 000
25 000	1 050 000	24 000
30 000	1 260 000	28 000
35 000	1 470 000	31 000
40 000	1 680 000	34 000
45 000	1 890 000	37 000
50 000	2 100 000	40 000
60 000	2 520 000	44 000
70 000	2 940 000	48 000
80 000	3 360 000	52 000
90 000	3 780 000	56 000
100 000	4 200 000	60 000
120 000	5 040 000	68 000
140 000	5 880 000	75 000
160 000	6 720 000	82 000
180 000	7 560 000	90 000

TANK CAPACITY, m^3	OUTBREATHING (FLASH POINT < 38°C OR NORMAL BOILING POINT < 149°C), Nm^3/h AIR
10	1,6
20	2,7
100	13,4
200	26,8
300	53,6
500	80,4
700	107
1000	134
1500	268
2000	402
3000	536
3180	643
4000	750
5000	831
6000	911
7000	992
8000	1072
9000	1179
10 000	1286
12 000	1394
14 000	1501
16 000	1608
18 000	1822
20 000	2010
25 000	2198
30 000	2412

***Table 6**. Flow Rate Conversion[1]*

MULTIPLY MAXIMUM PUMP RATE OUT:	BY	TO OBTAIN[1]:
U.S. GPM	8.021	SCFH
U.S. GPH	0.1337	SCFH
m^3/hr	1.01	Nm^3/h
Barrels/hour	5.615	SCFH
Barrels/day	0.2340	SCFH

1. Gas flow of blanketing gas to replace liquid pumped out.

***Table 7.** Capacities*

OUTLET PRESSURE RANGE, SPRING PART NUMBER, AND COLOR	SET PRESSURE	BUILDUP TO OBTAIN WIDE-OPEN TRAVEL	OUTLET PRESSURE VACUUM	CAPACITIES IN SCFH (Nm^3/h) OF 0.97 SPECIFIC GRAVITY NITROGEN
2 to 5-inches w.c. (5 to 12 mbar) 1A200127022, Red	2-inches w.c. (5 mbar)	2.6-inches w.c. (6 mbar)	0 psig (0 bar) 2.5 psig (0,17 bar) 5 psig (0,34 bar)	1420 (38,1) 5130 (137) 6560 (176)
	4-inches w.c. (10 mbar)	2.6-inches w.c. (6 mbar)	0 psig (0 bar) 2.5 psig (0,17 bar) 5 psig (0,34 bar)	1680 (45,0) 5200 (139) 6600 (177)
5 to 15-inches w.c. (12 to 37 mbar) 1B766627062, Gray	15-inches w.c. (37 mbar)	3.9-inches w.c. (10 mbar)	0 psig (0 bar) 2.5 psig (0,17 bar) 5 psig (0,34 bar)	2810 (75,3) 5580 (150) 6850 (184)
8-inches w.c. to 1 psig (20 to 69 mbar) 0B019427052, Dark Green	21-inches w.c. (52 mbar)	7.7-inches w.c. (19 mbar)	0 psig (0 bar) 2.5 psig (0,17 bar) 5 psig (0,34 bar)	3510 (94,1) 5950 (159) 7160 (192)
1 to 2.8 psig (69 mbar to 0,19 bar) 0A081127202, Orange	2 psig (0,14 bar)	23-inches w.c. (57 mbar)	0 psig (0 bar) 2.5 psig (0,17 bar) 5 psig (0,34 bar)	5820 (156) 7410 (199) 8340 (224)
2 to 3.5 psig (0,14 to 0,24 bar) 0Y066427022, Green Stripe	3 psig (0,21 bar)	3.2 psig (0,22 bar)	0 psig (0 bar) 2.5 psig (0,17 bar) 5 psig (0,34 bar)	8790 (236) 9770 (262) 10 400 (279)
4 to 7 psig (0,28 to 0,48 bar) 1H802427032, Red	5 psig (0,34 bar)	5.87 psig (0,41 bar)	0 psig (0 bar) 2.5 psig (0,17 bar) 5 psig (0,34 bar)	12 000 (322) 12 700 (340) 13 100 (351)

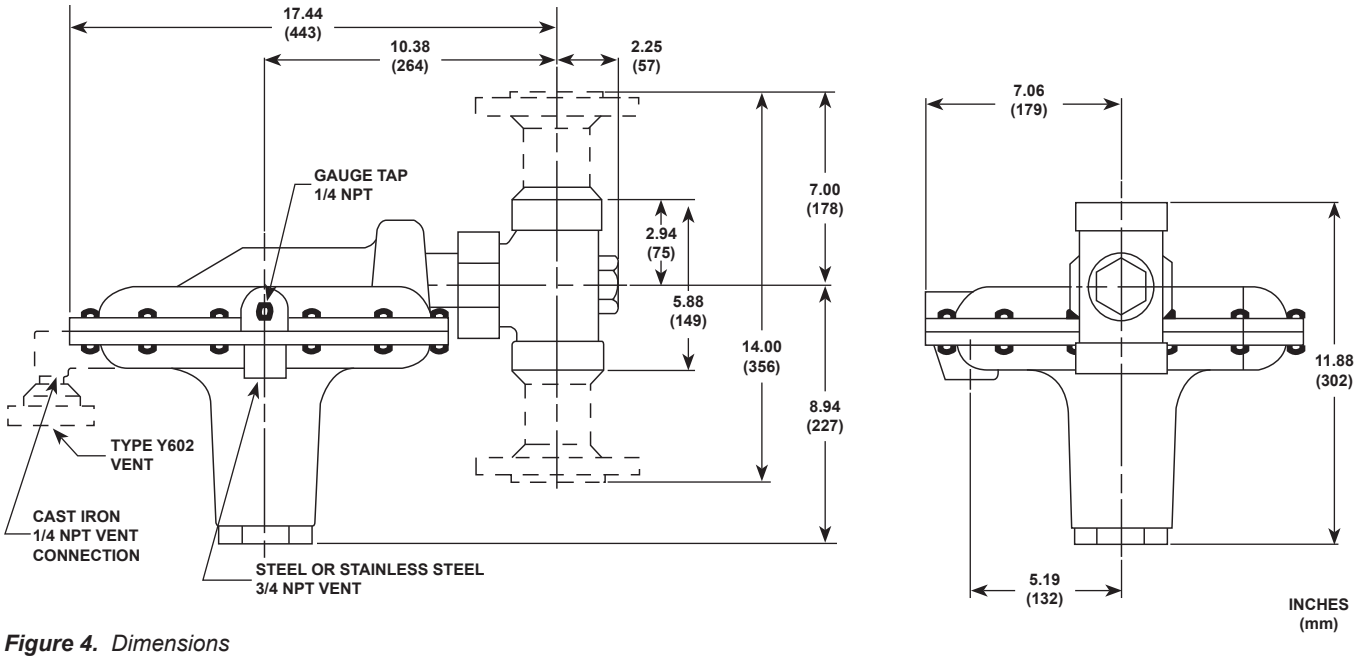

Figure 4. *Dimensions*

To determine regulating capacities at pressure settings not given or to determine wide-open flow capacities, use the following formula:

$$Q = \sqrt{\frac{520}{GT}}\, C_g P_1 SIN \left(\frac{3417}{C_1} \sqrt{\frac{\Delta P}{P_1}} \right) DEG$$

where:

Q = gas flow rate, SCFH
C_g = gas sizing coefficient
P_1 = absolute inlet pressure, psia
G = specific gravity of the gas
T = absolute temperature of gas at inlet, °Rankine
C_1 = flow coefficient
ΔP = pressure drop across the regulator, psi

Installation

Install the regulator using a straight run of pipe the same size as or larger than the regulator body. Flow through the regulator body is indicated by the flow arrow cast, stamped or riveted on the body. If a block valve is required, install a full flow valve between the regulator and the blanketed vessel. For proper operation at low setpoint ranges, the Type Y696 regulators should be installed with the spring case barrel pointed down.

Ordering Information

Carefully review each specification and complete the Ordering Guide. To ensure ordering accuracy, please complete the Specifications Worksheet on the last page.

Ordering Guide

Body Size (Select One)
- ☐ NPS 1-1/2 (DN 40)
- ☐ NPS 2 (DN 50)

Body Material and End Connection Style (Select One)

Cast Iron
- ☐ NPT***

Hastelloy® C
- ☐ NPT*
- ☐ CL150 RF*
- ☐ CL300 RF*

WCC Steel
- ☐ NPT***
- ☐ CL150 RF**
- ☐ CL300 RF**
- ☐ PN 16/25/40*

CF8M Stainless Steel
- ☐ NPT**
- ☐ CL150 RF**
- ☐ CL300 RF**
- ☐ PN 16/25/40*

Spring Case Material (Select One)
- ☐ Cast iron***
- ☐ WCC Steel***
- ☐ CF8M Stainless steel**

Diaphragm Case Material (Select One)
- ☐ Cast iron***
- ☐ WCC Steel***
- ☐ CF8M Stainless steel**
- ☐ Hastelloy® C*

Trim Material (Select One)
- ☐ 303 Stainless steel***
- ☐ 316 Stainless steel (not available with Ethylenepropylene (EPDM))**
- ☐ Hastelloy® C (only available with PTFE)*

- continued -

Ordering Guide (continued)

Diaphragm Material (Select One)
- ☐ Nitrile (NBR) **(standard)*****
- ☐ Fluorocarbon (FKM)**
- ☐ Nitrile (NBR) with PTFE Protector**

Disk Material (Select One)
- ☐ Nitrile (NBR) **(standard)*****
- ☐ Fluorocarbon (FKM)***
- ☐ Perfluoroelastomer (FFKM)*
- ☐ Ethylenepropylene (EPDM)*
- ☐ PTFE*

Outlet Pressure Range (Select One)
- ☐ 2 to 5-inches w.c. (5 to 12 mbar) Red***
- ☐ 5 to 15-inches w.c. (12 to 37 mbar) Gray***
- ☐ 8-inches w.c. to 1 psig (20 to 69 mbar) Dark Green***
- ☐ 1 to 2.8 psig (69 mbar to 0,19 bar) Orange***
- ☐ 2 to 3.5 psig (0,14 to 0,24 bar) Green Stripe***
- ☐ 4 to 7 psig (0,28 to 0,48 bar) Red***

Regulators Quick Order Guide	
* * *	Standard - Readily Available for Shipment
* *	Non-Standard - Allow Additional Time for Shipment
*	Special Order, Constructed from Non-Stocked Parts. Consult your local Sales Office for Availability.
Availability of the product being ordered is determined by the component with the longest shipping time for the requested construction.	

Replacement Parts Kit (Optional)
- ☐ Yes, send one parts kit to match this order.

Vapor Recovery Specification Worksheet

Application Specifications:

Tank Size _____

Pump In Rate _____

Pump Out Rate _____

Blanketing Gas (Type and Specific Gravity) _____

Pressure Requirements:

Control Pressure Setting _____

Downstream Pressure _____

Maximum Flow (Q_{max}) _____

Build-up Limitations:

☐ 0.25-inches w.c. (0,6 mbar) ☐ 0.5-inches w.c. (1 mbar)
☐ 1-inch w.c. (2 mbar) ☐ 2-inches w.c. (5 mbar)
☐ Others _____

Other Specifications:

Is a tank blanketing regulator required? ☐ Yes ☐ No

Special Material Requirements: ☐ Ductile Iron ☐ Steel ☐ Stainless Steel ☐ Hastelloy® C ☐ Other _____

Other Requirements: _____

_____

_____

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